RAYTHEON

TECHNICAL INFORMATION SERVICE

Technical Information

CK5840
CK6205

SUBMINIATURE SHARP-CUTOFF PENTODES

The CK5840 and CK6205 are heater cathode type sharp—cutoff RF pentodes of subminiature construction capable of operation in the UHF region. Type CK6205 is identical to the CK5840 except for an external grid No. 3 connection. These types are characterized by long life and stable performance, and designed for service where severe conditions of high temperature, high altitude and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to circuit components without the use of sockets. Standard 8—pin subminiature sockets may be used by cutting the leads to 0.20" length.

MECHANICAL RATINGS: (Absolute Maximum)

Impact Acceleration (Shock)	450	G
Uniform Acceleration (Centrifuge Test)	1000	G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5	G
Bulb Temperature	220	°C
Altitude	80,000	Ft.

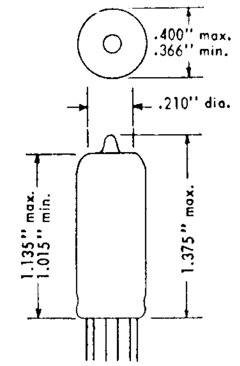
ELECTRICAL DATA

Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Normal Test Conditions	Test Limit or Absolute Maximum	MIL-E-1 Symbol
			Ratings			
Heater Voltage	Ef:	6.0	---	6.3	6.6	V
Plate Voltage	Eb:	---	---	100	165	Vdc
Grid Voltage	Ec1:	-55	---	0	0	Vdc
Grid #2 Voltage	Ec2:	---	---	100	155	Vdc
Grid #3 Voltage (Note A)	Ec3:	---	---	0	22	Vdc
Heater-Cathode Voltage	Ehk:	---	---	0	200	V
Cathode Resistance	Rk:	---	---	150	---	ohms
Grid Resistance	Rg1:	---	---	---	1.1	Meg
Cathode Current	Ik:	---	---	---	16.5	mAdc
Plate Dissipation	Pp:	---	---	---	0.90 *	W
Grid #2 Dissipation	Pg2:	---	---	---	0.30 *	W
* Design Maximum						
			Tests			
Plate Current (1)	Ib:	5.5	7.5	---	9.5	mAdc
Grid #2 Current	Ic2:	1.5	---	---	3.3	mAdc
Heater Current	If:	140	150	---	160	mA
Transconductance (1)	Gm:	4200	5000	---	5800	µmhos
Heater Cathode Leakage, Ehk=±100 Vdc	Ihk:	---	---	---	5.0	µAdc
Vibration (2) Low frequency F=40 cps; G=15; Rp=10,000; Ck=1000 µf	Ep:	---	---	---	60	mVac

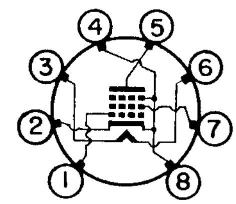
MECHANICAL DATA

ENVELOPE	T-3
OUTLINE	JEDEC (3-1)
BASE	Subminiature Button 8-Pin (0.017" tinned flexible leads. Length: 1.5" min.) E8-10
CATHODE	Coated Unipotential
BASING	8DL, 8DC
MOUNTING POSITION	Any

PHYSICAL DIMENSIONS



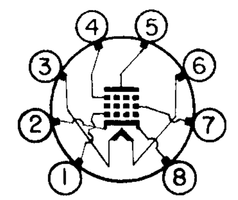
BASING – CK5840



TERMINAL CONNECTIONS: – 8DL

- Lead 1 Grid #1
- Lead 2 Cathode and Grid #3
- Lead 3 Heater
- Lead 4 Cathode and Grid #3
- Lead 5 Plate
- Lead 6 Heater
- Lead 7 Grid #2
- Lead 8 Cathode & Grid #3

BASING – CK6205



TERMINAL CONNECTIONS: – 8DC

- Lead 1 Grid #1
- Lead 2 Cathode and Shield
- Lead 3 Heater
- Lead 4 Grid #3
- Lead 5 Plate
- Lead 6 Heater
- Lead 7 Grid #2
- Lead 8 Cathode and Shield

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Ratings and Normal Operation	MIL-E-1 Symbol	Test Limit or Absolute Minimum	Normal Operation	Normal Test Conditions	Test Limit or Absolute Maximum	MIL-E-1 Symbol
			Tests (Continued)			
Transconductance (2) Ef = 5.7 V	Δ_{Ef}Gm:	---	---	---	10	%
Plate Resistance	rp:	0.175	---	---	---	Meg.
Interelectrode	Cg1p:	---	---	---	0.015	pf
Capacitance	Cin:	3.5	---	---	4.9	pf
0.405 in. dia. shield	Cout:	2.9	---	---	3.9	pf

SPECIAL TESTS AND RATINGS TO INSURE RELIABILITY.

Randomly selected statistical samples are subjected to the following tests:

Shock Test – 450G. 30° hammer angle in Navy high impact shock machine. Sample subjected to twenty impact accelerations, five impact accelerations in each of four different positions.

Fatigue Test – 2.5G. Sample subjected to vibrational acceleration of 2.5G for 96 hours (32 hours in each of three positions). The sinusoidal vibration is applied at a fixed frequency between 25 and 60 cycles per second.

Glass Strain – A sample is subjected to a forty eight hour holding period at room temperature. The sample is immersed in water at 97–100°C for 15 seconds and immediately immersed in water at not more than 5°C. The sample is then dried at room temperature for 48 hours and inspected for evidence of air leaks.

Heater–Cycling Life Test – A sample is subjected to 2000 on–off heater cycles at the following conditions. Ef = 7.0 V; Ehk = 140 Vac and other elements floating. At the conclusion of this test the tubes will not show open heater or cathode circuits, or heater to cathode shorts.

Stability Life Test – Sample is operated for one hour to assure initial electrical stability (Δ_t Sm $<$ 10%). Ehk = +200 Vdc; Rg1 = 1.0 Meg; TA = Room.

Survival Rate Life Test – Sample is operated one hundred hours to assure electrical stability, (Gm $>$ 3750 μmhos) and freedom from inoperatives. Tubes are operated under stability life-test conditions.

Intermittent Life Test – 1000 hours. Sample is operated with minimum Envelope Temperature of 220°C, at stability life-test conditions.

Altitude – Sample is subjected to a pressure of 21 ± 2 mmHg (80,000 ft.) at 300 Vac to assure freedom from flashover or corona at the leads of the tube.

APPLICATION NOTES

CAUTION – – – To Electron Equipment Design Engineers. Special attention should be given to the temperature which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Both reliability and performance will be jeopardized if filament voltage ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

NOTE A: Types CK5840 and CK6205 are the same except for suppressor grid and cathode connections. The Ec3 column in the heading applies only to type CK6205. Type CK6205 has not been designed to use the number 3 grid for control or gating purposes.

ACCEPTANCE CRITERIA

The following tests shall be performed:
For the purpose of inspection, use applicable reliable paragraphs of Specification MIL-E-1.
For miscellaneous requirements, see 3.6.

Par. No.	Test (See Note 1)	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS (See Note 2)						Units
						Min	LAL	Bogie	UAL	Max	ALD	
GENERAL												
3.1	Qualification	Required for JAN marking	---	---	---	---	---	---	---	---	---	---
3.6	Performance		---	---	---	---	---	---	---	---	---	---
QUALIFICATION (see note 3)												
---	Cathode	Coated unipotential	---	---	---	---	---	---	---	---	---	---
3.4.3	Base Connections	E8-10	---	---	---	---	---	---	---	---	---	---
4.9.20.3	Variable frequency vibration (1)	No voltages applied; post shock and fatigue end points apply	---	---	---	---	---	---	---	---	---	---
MEASUREMENTS ACCEPTANCE TESTS, PART 1 (see note 4)												
4.10.8	Heater Current		---	---	If	---	144	150	156	---	12	mA
4.10.8	Heater Current		0.65	II	If	140	---	---	---	160	---	mA
4.10.15	Heater-Cathode Leakage	Ehk = + 100 Vdc Ehk = - 100 Vdc	.65	II	Ihk Ihk	--- ---	--- ---	--- ---	--- ---	5.0 5.0	--- ---	μAdc μAdc
4.10.6.1	Total Grid Current	Rg1 = 1.0 Meg	.65	II	Ic1	0	---	---	---	-0.3	---	μAdc
4.10.4.1	Plate Current (1)		---	---	Ib	---	6.7	7.5	8.3	---	2.3	mAdc
4.10.4.1	Plate Current (1)		.65	II	Ib	5.5	---	---	---	9.5	---	mAdc
4.10.4.1	Plate Current (2)	Ec1=-9.0 Vdc; Rk=0	.65	II	Ib	---	---	---	---	50	---	μAdc
4.10.4.3	Screen-Grid Current		.65	II	Ic2	1.5	---	---	---	3.3	---	mAdc
4.10.9	Transconductance (1)		---	---	Sm	---	4700	5000	5300	---	900	μmhos
4.10.9	Transconductance (1)		.65	II	Sm	4200	---	---	---	5800	---	μmhos
4.7.5	Continuity and Short Tests (for reliable tubes) (inoperatives)		.40	II	---	---	---	---	---	---	---	
---	Suppressor	(See note 5)	.40	II	---	---	---	---	---	---	---	
4.9.1.1	Mechanical production tests (for reliable subminiature tubes)	Outline 8-1			---	---	---	---	---	---	---	

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Symbol	LIMITS (See Note 2) Min	LAL	Bogie	UAL	Max	ALD	Units
MEASUREMENTS ACCEPTANCE TESTS, PART 2												
4.8	Insulation of electrodes	g1 – all p – all	2.5	I	R R	100 100	--- ---	--- ---	--- ---	--- ---	--- ---	Meg Meg
4.10.9	Transconductance (2)	Ef = 5.7 V	2.5	I	$\Delta_{Ef}Sm$	---	---	---	---	10	---	%
4.10.6.2	Grid Emission	Ef = 7.5 V; Ec1 = –9.0 Vdc; Rg1 = 1.0 Meg; Rk = 0 (see note 6)	2.5	I	Ic1	0	---	---	---	–0.5	---	μAdc
4.10.3.2	Auto-frequency noise	Esig = 70 mVac; Ec2 = 19 Vdc; Rg1 = 0.1 Meg; Rg2 = 1,000; Rp = 0.2 Meg; Ck = 1,000 μf (see note 7)	2.5	I		---	---	---	---	---	---	
4.10.10	Plate Resistance		6.5	L6	rp	0.175	---	---	---	---	---	Meg
4.10.14	Direct Interelectrode capacitance	0.405 in. dia. shield 0.405 in. dia. shield 0.405 in. dia. shield	6.5	Code F	Cg1p Cin Cout	--- 3.5 2.9	--- --- ---	--- --- ---	--- --- ---	0.015 4.9 3.9	--- --- ---	pf pf pf
4.9.12.1	Low-pressure voltage breakdown	Pressure = 21±2 mm Hg; voltage = 300 Vac (see note 8)	6.5	(See note 9)		---	---	---	---	---	---	
4.9.19.1	Low-frequency vibration (2)	Rp = 10,000; Ck = 1,000 μf; F = 40 cps; G = 15	2.5	I	Ep	---	---	---	---	60	---	mVac
DEGRADATION RATE ACCEPTANCE TESTS, (see note 10)												
4.9.5.3	Subminiature lead fatigue		2.5	Code F		4	---	---	---	---	---	arcs
4.9.20.5	Shock test	Hammer angle = 30°; Ehk = + 100 Vdc (see note 11)	---	---		---	---	---	---	---	---	
4.9.20.6	Fatigue test	G = 2.5; fixed frequency; F = 25 min. 60 max.	6.5	(See note 9)		---	---	---	---	---	---	
---	Post shock and fatigue test end points	Vibration (2)	---	---	Ep	---	---	---	---	200	---	mVac
		Heater-cathode leakage Ehk = + 100 Vdc Ehk = – 100 Vdc	--- ---	--- ---	Ihk Ihk	--- ---	--- ---	--- ---	--- ---	20 20	--- ---	μAdc μAdc
		Change in transconductance (1) of individual tubes	---	---	$\Delta_t Sm$	---	---	---	---	20	---	%
4.9.6.3	Glass strain		6.5	I		---	---	---	---	---	---	

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Allowable Defects per Characteristic		Symbol	LIMITS		Units
					First Sample	Combined Samples		Min	Max	
ACCEPTANCE LIFE TESTS (see note 10)										
4.11.7	Heater-cycling life test	Ef = 7.0 V; 1 min. on, 4 min. off; Ehk = 140 Vac; Ec1 = Ec2 = Eb = 0 (see note 12)	2.5	Code II	---	---		---	---	
4.11.3.1(a)	Stability life test (1 hour)	Ehk = +200 Vdc; Rg = 1.0 Meg; TA = room (see note 13)	1.0	Code I	---	---		---	---	
4.11.4	Life test end points (stability)	Change in transconductance (1) of individual tubes	---	---	---	---	Δ_t Sm	---	10	%
4.11.3.1(b)	Survival-rate life test	Stability life test conditions or equivalent; TA = room (see notes 14 and 15)	---	II	---	---		---	---	
4.11.4	Life test end points (survival)	Continuity and short (Inoperatives)	0.65	---	---	---	---	---	---	
		Transconductance (1)	1.0	---	---	---	Sm	3750	---	µmhos
4.11.5	Intermittent life-test operation	Stability life test conditions; T (envelope) = +220°C min (see notes 16 and 17)	---	---	---	---	---	---	---	
4.11.4	Life test end points (500 hours)	(See note 18)								
		Inoperatives (see note 19)	---	---	1	3		---	---	
		Grid current	---	---	1	3	Ic1	0	-0.8	µAdc
		Heater current	---	---	1	3	If	138	164	mA
		Change in transconductance (1) of individual tubes	---	---	1	3	Δ_t Sm	---	20	%
		Transconductance (2)	---	---	1	3	Δ_{Ef} Sm	---	15	%
		Heater-cathode leakage								
		Ehk = +100 Vdc	---	---	1	3	Ihk	---	10	µAdc
		Ehk = -100 Vdc					Ihk	---	10	µAdc
		Insulation of electrodes								
		g - all	---	---	1	3	R	25	---	Meg
		p - all					R	25	---	Meg
		Transconductance (1) average change	---	---	---	---	Avg Δ_t Sm	---	15	%
		Total defectives	---	---	3	6	---	---	---	---

Par. No.	Test	Conditions	AQL (Percent Defective)	Inspection Level or Code	Allowable Defects per Characteristic		Symbol	LIMITS		Units
					First Sample	Combined Samples		Min	Max	
4.11.4	Life test end points (1000 hours)	(See note 18)								
		Inoperatives (see note 19)	---	---	1	3		---	---	
		Grid current	---	---	1	3	Ic1	0	−0.8	μAdc
		Heater current	---	---	1	3	If	138	164	mA
		Change in transconductance (1) of individual tubes	---	---	1	3	Δ_t Sm	---	25	%
		Transconductance (2)	---	---	1	3	Δ_{Ef} Sm	---	20	%
		Heater-cathode leakage Ehk = + 100 Vdc	---	---	1	3	Ihk	---	10	μAdc
		Ehk = − 100 Vdc					Ihk	---	10	μAdc
		Insulation of electrodes g − all	---	---	1	3	R	25	---	Meg
		p − all					R	25	---	Meg
		Total defectives	---	---	4	8	---	---	---	---
4.9.18	Container drop	(d) Package group 1; container size C								

NOTES:

Note 1: The sequence of tests used in this specification is the suggested order of tests, which has been determined to be most convenient for both the tube manufacturer and the Government laboratories.

Note 2: Variable sampling procedures. (See 4.1.1.7)

Note 3: All tests listed hereon shall be performed during qualification inspection, however, these three tests will normally be performed during qualification inspection only.

Note 4: The AQL for the combined defectives for attributes in measurements acceptance tests, part 1, excluding inoperatives and mechanical, shall be one (1) percent.

Note 5: Tube JAN-6205 shall be subjected to the following test or equivalent: Reject for open suppressor if plate current does not decrease by a minimum of 10 percent when Ec3 is changed from 0 to −100 Vdc.

Note 6: Prior to this test, tubes shall be preheated 5 minutes at conditions indicated below. The 3-minute test is not permitted. Test at specified conditions within 3 seconds after preheating. Grid emission shall be the last test performed on the sample selected for the grid emission test.

Ef	Ec1	Ec2	Ec3	Eb	Rk	Rg1
V	Vdc	Vdc	Vdc	Vdc	ohms	Meg
7.5	0	100	0	100	150	1.0

Note 7: The rejection level shall be set at the VU meter reading obtained during calibration.

Note 8: No other voltages applied.

Note 9: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. When one lot has passed, the 30-day rule shall apply. In the event of lot failure the lot shall be rejected and the succeeding lots shall be subjected to this test until a lot passes. Standard MIL-STD-105, sample size code letter F shall apply.

NOTES (continued)

Note 10: Destructive tests. Tubes subjected to the following destructive tests are not to be accepted under this specification.

- 4.9.5.3 Subminiature lead fatigue
- 4.9.20.5 Shock test
- 4.9.20.6 Fatigue test
- 4.11.7 Heater-cycling life test
- 4.11.5 Intermittent life-test operation

Note 11: A grid resistor of 0.1 megohm shall be added, however, this resistor will not be used when a thyratron-type short indicator is employed.

Note 12: The no-load to steady state full load regulation of the heater voltage supply shall be not more than 3.0 percent. This test shall be made on a lot-by-lot basis. A failure or defect shall consist of an open heater, open cathode circuit, or heater-cathode short.

Note 13: Stability life test. The sampling and testing procedures for this test shall be in accordance with 20.2.5.1(a) to 20.2.5.1 (g), inclusive, of appendix C.

Note 14: Survival rate life test. The sampling and testing procedures for this test shall be as defined in 20.2.5.2 to 20.2.5.2.4 inclusive, of appendix C.

Note 15: For survival life test, the equivalent stability life test conditions shall be as defined in 20.2.5.2.5 of appendix C.

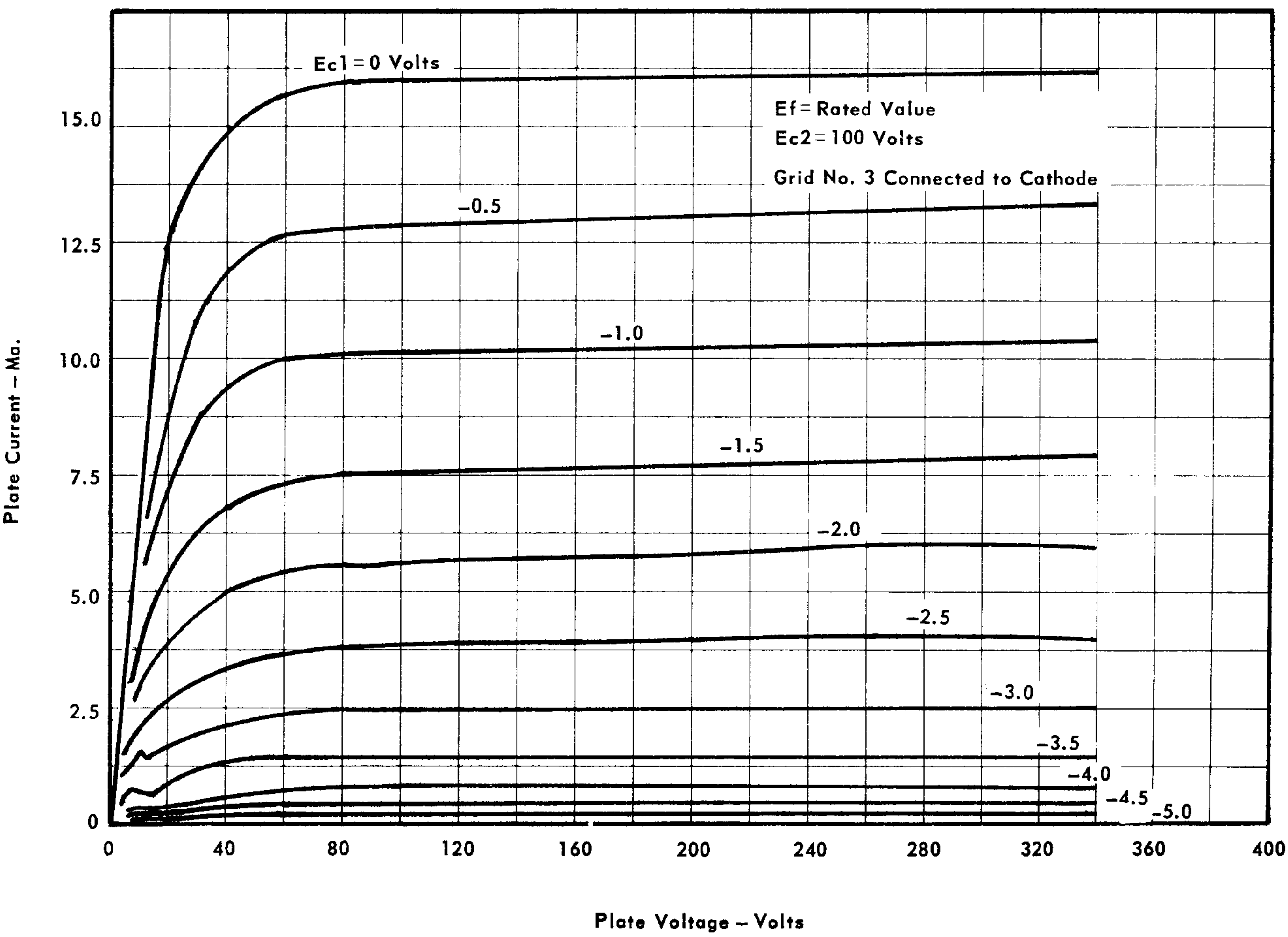
Note 16: Intermittent life tests. Sampling and acceptance procedures for these tests shall be as defined in 20.2.5.3(a) to 20.2.5.3 (i), inclusive, of appendix C.

Note 17: Envelope temperature is defined as the highest temperature indicated when using a thermocouple of No. 40 B & S or smaller diameter elements welded to a ring of 0.025 inch diameter phosphor bronze in contact with the envelope. Envelope temperature requirements will be satisfied if tube, having bogie Ib (±5 percent) under normal test conditions, is determined to operate at minimum specified temperature at any position in the life test rack.

Note 18: Order for evaluation of life test. See 4.11.3.1.2.

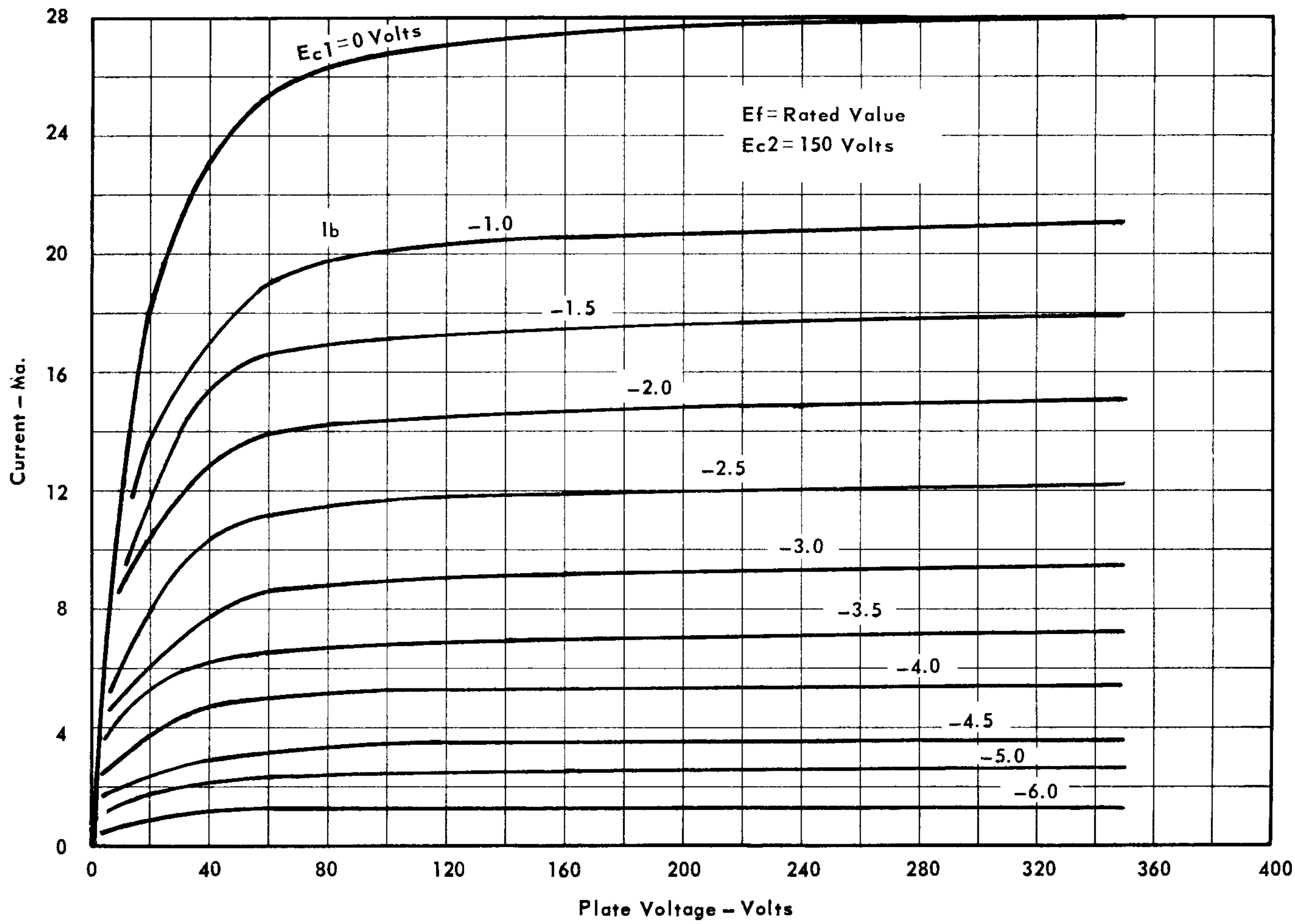
Note 19: An inoperative as referenced in life test is defined as a tube having one or more of the following defects: Discontinuity (see 4.7.1); Shorts (see 4.7.2); Air leaks (see 4.7.6).

AVERAGE PLATE CHARACTERISTICS
(Pentode Connected)

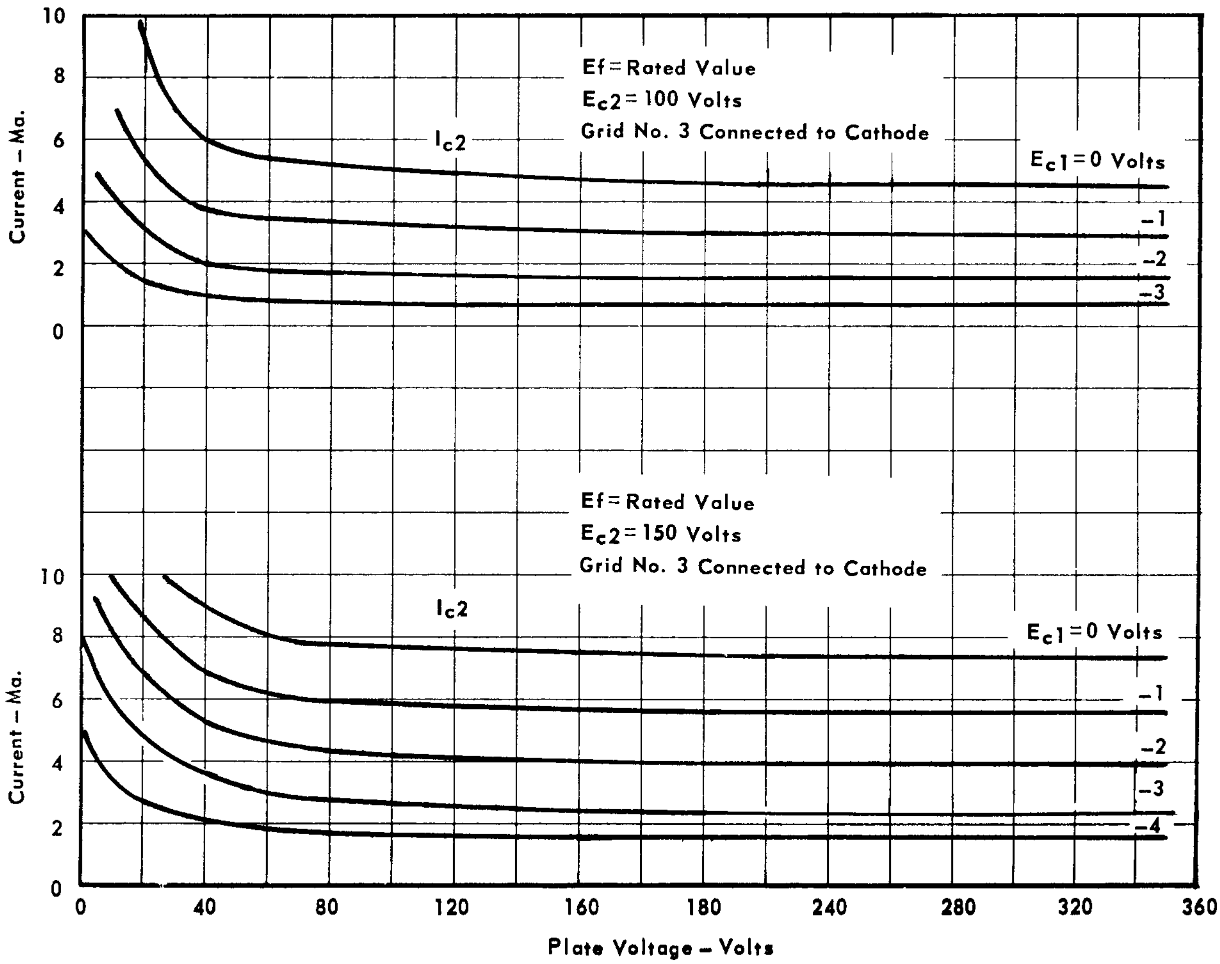


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AVERAGE PLATE CHARACTERISTICS
(Pentode Connected)

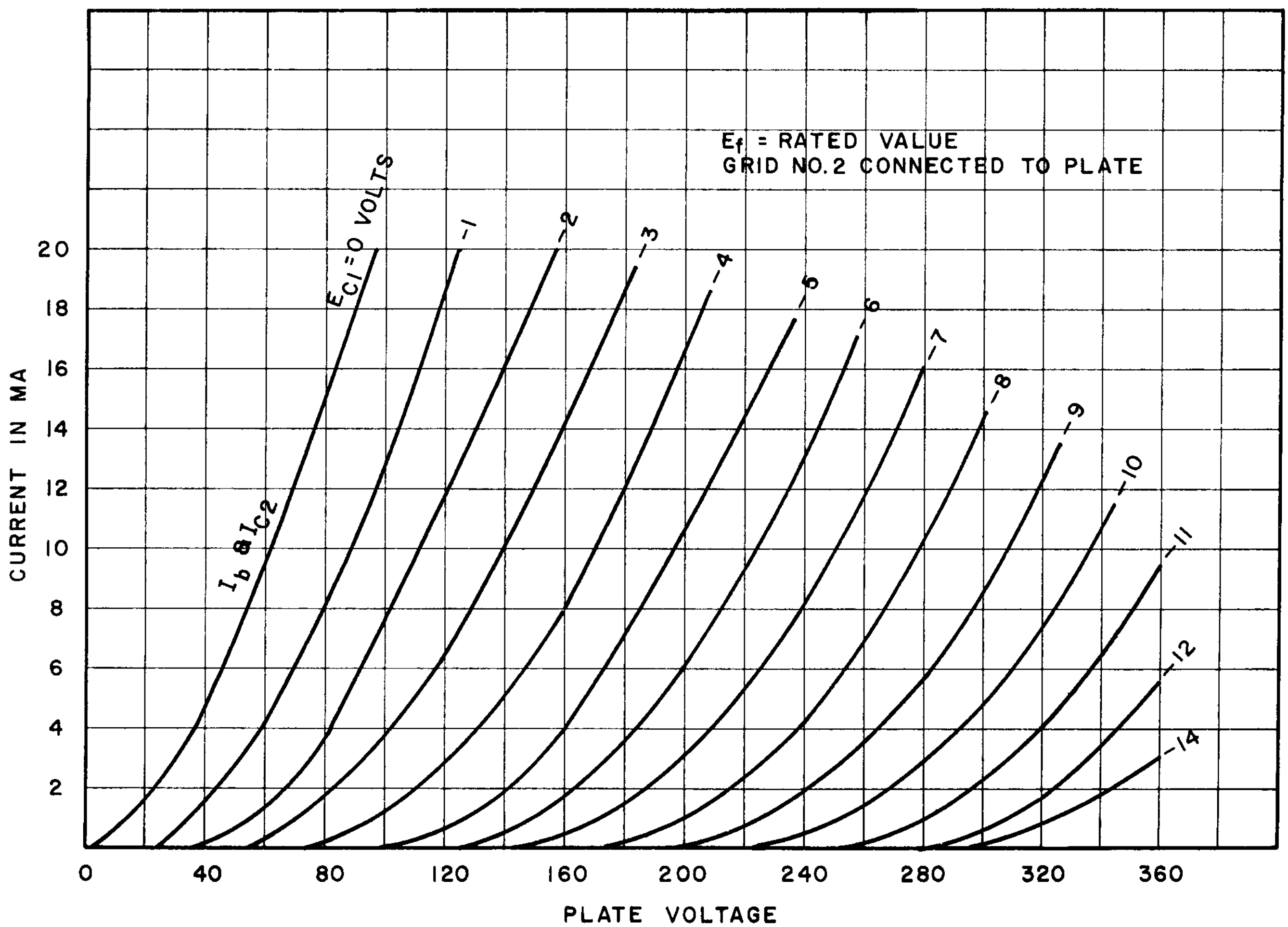


AVERAGE GRID #2 CHARACTERISTICS
(Pentode Connected)

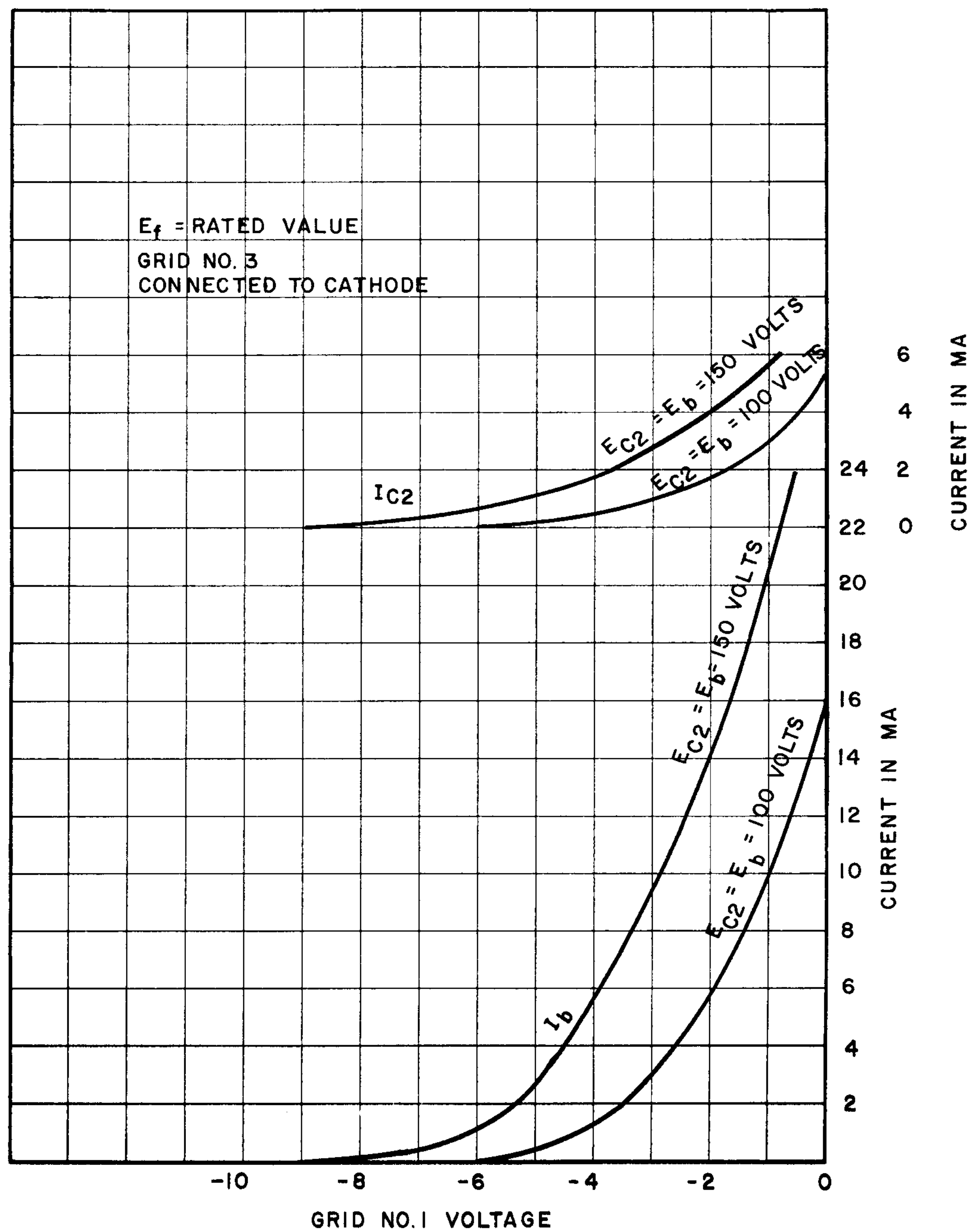


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AVERAGE PLATE CHARACTERISTICS
(TRIODE CONNECTED)



AVERAGE TRANSFER CHARACTERISTICS
(PENTODE CONNECTED)



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AVERAGE TRANSFER CHARACTERISTICS
(Pentode Connected)

